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Effectiveness of Instruction Performed through Computer-Assisted Activity Schedules on On-Schedule and Role-Play Skills of Children with Autism Spectrum Disorder

Burcu Ulke-Kurkcuoglu[a]
Anadolu University

Funda Bozkurt[b]
Anadolu University

Selmin Cuhadar[c]
Trakya University

Abstract
This study aims to investigate the effectiveness of the instruction process provided through computer-assisted activity schedules in the instruction of on-schedule and role-play skills to children with autism spectrum disorder. Herein, a multiple probe design with probe conditions across participants among single subject designs was used. Four children aged between four and ten participated in the study. The findings of the study showed that the instruction process provided through computer-assisted activity schedules has an effect upon the acquisition, maintenance, and generalization of the on-schedule and role-play skills of the children participating in the study. With respect to the social validity findings of the study, families and teachers gave positive opinions about the instruction process. In this paper, the findings obtained from the study are discussed and suggestions are made regarding implications and future research.

Keywords: Autism spectrum disorder • Activity schedules • Role-play skills • Computer assisted • On-schedule

a **Corresponding author**
Assoc. Prof. Burcu Ulke-Kurkcuoglu (PhD), Research Institute for the Handicapped, Anadolu University, Yunus Emre Campus, Eskisehir 26470 Turkey
Research areas: Applied behavior analysis; Children with autism spectrum disorder and their education
Email: bulkekurkcuoglu@anadolu.edu.tr

b Funda Bozkurt (PhD), Department of Special Education, Faculty of Education, Anadolu University, Yunus Emre Campus, Eskisehir 26470 Turkey
Email: fundab@anadolu.edu.tr

c Assist. Prof. Selmin Cuhadar (PhD), Department of Special Education, Faculty of Education, Trakya University, Mehmet Akif Ersoy Education Building, Edirne, Turkey
Email: selmincuhadar@trakya.edu.tr

Autism spectrum disorder (ASD) is a neurobiological and complex developmental disability (Haney, 2013; Kircaali-Iftar, 2012). According to the DSM IV-TR guidelines published by the American Psychiatric Association (APA) (2000), which were widely used in the diagnosis of ASD until recently, ASD becomes visible through (*a*) problems with social interaction, (*b*) communication problems, and (*c*) limited and repeated interests and behaviors. The communication problems specified in these guidelines are a delay in language development, difficulty in having a conversation, atypical or repetitive language, and play that is inappropriate to the developmental level. Problems such as incapability in imaginative and symbolic play and indifference toward social play stand out as demonstrating play skills that are inappropriate to the developmental level. Social interaction and communication problems are examined together in the DSM-5 guidelines published in 2013, after DSM IV-TR. According to DSM-5, ASD manifests itself via (*a*) widespread and persistent deficits in social communication and social interaction across multiple contexts and (*b*) restricted and repetitive patterns in behavior, interests, or activities (APA, 2013; Kircaali-Iftar, 2012). In DSM-5, problems such as difficulties in sharing imaginative play and making friends and the absence of interest in peers are emphasized among social communication and social interaction deficits, and it is stated that individuals with ASD lack abilities in developing, maintaining, and understanding relationships (APA, 2013). Thus, when both sets of guidelines are examined, it is understood that deficits in play skills have an important role in the diagnosis of ASD.

Play is a means that ensures that children interact and obtain new information on their environment by using various facets of their present accumulation of knowledge, gaining experience and supporting their identity development, cooperation skills, and creativity (Barton & Wolery, 2008; Lifter, Foster-Sanda, Arzamarski, Briesch, & McClure, 2011; Morrison, Sainato, Benchaan, & Endo, 2002; Naber et al., 2008). Play contributes significantly to the cognitive, social, emotional, linguistic, and physical development of children (Lifter et al., 2011; Phillips & Beavan, 2012). In children who show typical development, the playing skill emerges on its own, with limited adult assistance and modeling, and has the quality of being a natural reinforcer (Lovaas, 2003). The development of play skills in children with ASD differs significantly from that of their peers in terms of participating in play activities and peer interaction (Liber, Frea, & Symon, 2008). Children with ASD tend to occupy themselves with part of an object for a period of time, and their interaction with the item often cannot be regarded as play because the object is not used in line with its purpose (e.g., removing a toy car's wheels and spinning them around, shaking part of a toy with a hand) (Naber et al., 2008; Rutherford, Young, Hepburn, & Rogers, 2007). Here, it seems that the play of children with ASD, who are limited, ritualized, and removed from social interaction, cannot go beyond stereotypic behaviors (Lovaas, 2003). Furthermore, their avoidance of social interaction with peers who show typical development in preference for being alone and their deficits in the skills needed for playing games constitute the basis for these children being alienated by their peers (Wolfberg, 1999).

Role-plays are among the games played by children showing typical development. This type of play emerges at approximately 18 months and becomes more complex as different fields of development, such as cognitive, social, and linguistic development, are strengthened (Barton & Wolery, 2008). Children showing typical development initially play simple games such as feeding the baby and parking the car in the garage, but later, they play more complex forms of these games by adding symbolic elements. Children with ASD engage in role-play less frequently and when they do, the games are less diverse (Barton, 2010). Indeed, it has been found that the social interaction and communication problems experienced by these children reflect negatively on their role-playing skills (Hobson, Hobson, Malik, Bargiota, & Calo, 2013). It is necessary for children with ASD to learn to role-play in order to support the development of skills such as (*a*) understanding the relationships between the events/situations/objects around them, (*b*) interacting with their peers by playing more qualified games, (*c*) being aware of the emotions and thoughts of the people around them by rehearsing real life through play, (*d*) thinking about incidents, solving problems, and reasoning, and (*e*) using verbal and non-verbal language in the play (Barton & Pavilanis, 2012; Phillips & Beavan, 2012). Systematic instruction is necessary for children with ASD to be able to learn role-play games (Barton & Pavilanis, 2012).

As practices for educating children with ASD are increased, the scientific bases of such practices are being questioned. Practices such as errorless teaching, activity schedules, pivotal response training, and video modeling are regarded as having scientific bases (Wong et al., 2014). An evidence-

based practice, the activity schedule is used with a view to eliminating the deficiencies experienced by individuals with ASD by emphasizing the skills that they obtain with no antecedent stimulus or prompts (Kircaali-Iftar, 2007). An activity schedule is defined as "a set of words or pictures that are prompts/stimulants in order for the individual to be able to fulfill the chain of activity" (McClannahan & Krantz, 1999). These schedules can be prepared by using pictures or text, in line with the characteristics of the individual. Activity schedules can be prepared in a more detailed way, using pictures/text relating to each step in ability, or in a more generalized way by providing the child with symbols/pictures that constitute premises for the child to start the activity in question (Birkan, 2013; McClannahan & Krantz, 1999). The pictures/photographs and/or text can be provided either in a folder or in the form of a checklist – in the existing literature, activity schedules are prepared frequently using the folder method (Bryan & Gast, 2000; Cuhadar & Diken, 2010; MacDuff, Krantz, & McClannahan, 1993). In such examples, graduated guidance is generally included in the instructions provided via activity schedules. In more recent studies, methods such as least-to-most prompting (Pierce, Spriggs, Gast, & Luscre, 2013) and progressive time delay (Carlile, Reeve, Reeve, & DeBar, 2013) have also been used together with activity schedules.

A number of studies have examined the effectiveness of the instructions provided through activity schedules in terms of the skills of individuals with ASD, in particular. The findings of these researchers show that activity schedules are effective in relation to leisure-time skills (Cuhadar & Diken, 2010; MacDuff et al., 1993), daily life (Krantz, MacDuff, McClannahan, 1993), on-schedule skills (Bryan & Gast, 2000), and play skills (Machalicek et al., 2009; Morrison et al., 2002). In addition, researchers have investigated the effect of activity schedules upon peer interaction (Betz, Higbee, & Reagon, 2008), engagement in activities (Massey & Wheeler, 2000), and problem behaviors (Lequia, Machalicek, & Rispoli, 2012). The findings show that activity schedules increase social interaction, engagement, and transition between activities, while decreasing problem behaviors (Banda & Grimmet, 2008; Lequia et al., 2012).

Given the rapid development of technology, it has been indicated that tools such as laptop computers, iPods, and iPads should be used in educational environments (Koyama & Wang, 2011). The results of the numerous studies in this area indicate that computer-assisted instruction is effective in the acquisition, maintenance, and generalization of various skills in individuals with ASD (Penington, 2010). Research has also been conducted into the use of activity schedules in the computer environment; to date, however, these studies are limited in number (Carlile et al., 2013; Cihak, 2011; Dauphin, Kinney, & Stromer, 2004; Kimball, Kinney, Taylor, & Stromer, 2003, 2004). In general, existing studies have used PowerPoint software (Microsoft) for the creation of computer-assisted activity schedules (Dauphin, et al., 2004; Kimball et al., 2003, 2004). Indeed, the use of this software, which is utilized frequently by teachers in general education settings, is also advocated for the education of the children with special needs (Rehfeldt, Kinney, Root, & Stromer, 2004; Stromer, Kimball, Kinney, & Taylor, 2006). With the exception of a few projects, research into computer-assisted activity schedules tends to be based on case studies (Kimball et al., 2003, 2004). Thus, more extensive research, in terms of the method through which experimental control is established, is needed in this area. Beginning from this need, this study aims to determine whether the instruction process provided by computer-assisted activity schedules is effective in the instruction of on-schedule and role-play skills to children with ASD. In line with this purpose, the following questions are addressed: (*a*) Is the instruction process provided using computer-assisted activity schedules effective upon the acquisition, maintenance, and generalization of on-schedule skills? (*b*) Is the instruction process provided through computer-assisted activity schedules effective upon the acquisition, maintenance, and generalization of role-play skills? (*c*) What are the opinions of the teachers and families of the children in the study with respect to the instruction process and targeted skills provided through computer-assisted activity schedules?

Method

Participants

Subjects: The participants in the study were four male students with ASD attending the Unit for Children with Developmental Disabilities at Anadolu University. These students were chosen according to permission given by their parents for them to participate in the study, agreement from class teachers to include independence-giving works in classes, the inclusion of instruction regarding role-play skills in the students' Individualized Education Plans, and the fulfillment

of prerequisite skills. These prerequisites, related to the use of the computer and the activity schedule were determined for subjects to participate in the study . The prerequisite skills for computer use were as follows: (*a*) ability to participate in an activity for a period of 2-3 minutes, (*b*) ability to follow verbal commands, and (*c*) ability to watch an image on the computer screen for at least 2 minutes. In order to assess these skills, the subjects were observed in their classroom and their performance was evaluated. The prerequisite and facilitating skills in relation to the illustrated activity schedule were: (*a*) ability to discriminate between the picture and the background, (*b*) ability to match the same/similar objects, (*c*) ability to match pictures and objects, and (*d*) willingness to accept physical assistance (manual steering) (McClannahan & Krantz, 1999). Three sessions, each consisting of two trials, were held in order to assess each prerequisite and each facilitating skill, and the students demonstrating 100% performance were recruited for the study. The characteristics of the subjects are given below:

Burak is a male student aged 6. He has been receiving one-to-one training twice a week at a rehabilitation center for the last three years, as well as group training five half-days per week at the Unit for Children with Developmental Disabilities. Burak has basic matching and imitation skills. He shows functional play skills, such as the ability to complete jigsaw puzzles, play with a shape box. He follows simple verbal commands but does not have expressive verbal language skills. Burak makes out-of-context sounds such as "aaaa" and "oooo," which are vocal stereotype. He can direct his attention to activities for approximately 5 minutes and is able to complete activities only with guidance from a teacher. Burak has not been instructed on the use of the activity schedule before.

Can is a male student aged four. Can receives one-to-one training from a special trainer five days a week for two hours per day. He has also been receiving individual training at a private training and education center twice a day for one year, and at the Unit for Children with Developmental Disabilities twice a day for two years. He has also been attending nursery for two years. Can has basic matching and imitation skills. He shows functional play skills, such as the ability to complete jigsaw puzzles and play with a shape box. He follows simple verbal commands but does not have expressive verbal language skills. Can makes out-of-context, meaningless sounds such as "bisbis," which are vocal stereotype. He can direct his attention to activities approximately for 5 minutes and is able to complete activities only with guidance from a teacher. Can has not been instructed on the use of the activity schedule before.

Omer is a male student aged 10. Omer has been receiving group training at the Unit for Children with Developmental Disabilities five half-days a week for four years. He also receives individual training at a private training and rehabilitation center. He left the Developmental Disability Practice Unit during the research process and began to receive training at the Autistic Children Training Centre. Omer has basic matching and imitation skills. He shows functional play skills, such as the ability to complete jigsaw puzzles, play with a shape box. He follows simple verbal commands but does not have expressive verbal language skills. Omer shows stereotyped behaviors, such as wringing his hands and swinging from side to side. He can direct his attention to activities for approximately 5 minutes and is able to complete activities only with guidance from a teacher. He also demonstrates obsessive behaviors, such as constantly washing his hands and face. Omer has not been instructed on the use of the activity schedule before.

Alp is a male student aged 4. Alp has been receiving one-to-one training from special education teachers at home five days a week for one year, and also receives individual training twice a week at the Unit for Children with Developmental Disabilities. Alp has basic matching and imitation skills. He shows functional play skills, such as the ability to complete jigsaw puzzles and play with the shape box. He follows verbal commands but does not have expressive verbal language skills. Alp demonstrates stereotyped behaviors such as putting the collar of his T-shirt in his mouth and swinging his hands from side to side, keeping his hands at eye level and moving his fingers. He can direct his attention to activities for approximately 5 minutes and complete activities only with guidance from a teacher. Alp demonstrates problem behaviors during activities, such as struggling to sit still for a short time, crying heavily, and throwing himself on the ground when something he wants is not done. Alp has not been instructed on the use of the activity schedule before.

According to a report supplied by the families and by a state hospital, all of the subjects have been diagnosed with autism. Standardized test results on the performance of the subjects could not be obtained. Permission was obtained from the parents for their children to participate in the research.

Trainer: The study was conducted by the first author, and the second author recorded the study with a video camera. The trainer has a doctorate from Anadolu University, Institute of Educational Sciences, Department of Special Education, Program in Education of the Mentally Disabled. In addition, the trainer has 16 years' work experience in the implementation of evidence-based practices such as video models, activity schedules, and errorless teaching in teaching various skills to children with ASD.

Settings and Materials

In this research, all of the sessions held with the subjects, except for the generalization sessions, were conducted in one of the individual study rooms at the Unit for the Children with Developmental Disabilities. In this room, three square tables were joined together in an L shape. A laptop computer was placed on the short edge of the table with a chair in front of it. A rectangular table with a number of plastic containers on top was positioned right in front of the L-shaped table. Furthermore, a cupboard containing educational materials could be found in the room. The generalization sessions were held in the playroom, and the same setup was used in the playroom. The following materials were used throughout the research: (*a*) an activity schedule (prepared on the computer), and a laptop computer and mouse for maintaining the activity schedule, (*b*) tools for testing the skills required in the role-plays included in the activity schedule, and plastic containers in which to place these materials, (*c*) 15 cm x 10 cm photographs of the activities and skill steps, and (*d*) a video camera and tripod to record the sessions. Furthermore, data collection forms were used for the probe, instruction, maintenance, and generalization sessions in order to record student performance in relation to each target behavior.

Dependent and Independent Variables

The dependent variables consist of the on-schedule skill and the role-play skills. The skill steps listed for the on-schedule skill, which is the first main dependent variable of the research, are as follows: (*a*) directing one's attention to the computer screen in an appropriate manner (looking at the computer screen/gravitating toward the screen), (*b*) clicking on the first picture on the computer screen and opening the relevant presentation, (*c*) pointing to/indicating the picture on the first page, (*d*) taking materials from the cupboard shelf, (*e*) starting the first task on the schedule in 5 seconds, (*f*) defining the skill being tested, (*g*) moving on to other activities included in the illustrated activity schedule in an appropriate manner (putting materials back and returning back to the schedule).

Role-play skills constitute the second main dependent variable of the research. Three chain role-play skills were established as the sub-dependent variables of the second main dependent variable. In order to determine the relevant skills, a list consisting of the role-play skills used largely by preschool-aged children was prepared, taking

Table 1
Skill Analyses for Role-Play Skills

Playing with Baby Doll	Playing with Car	Setting the Table
1. Taking the cradle from the box	1. Taking the driveway from the box	1. Taking the American service from the box
2. Putting the cradle in an appropriate place	2. Putting the driveway in an appropriate place	2. Placing the American service on the table
3. Taking the bed from the box	3. Taking the model garage from the box	3. Taking the plate from the box
4. Putting the bed on the cradle toward the right or left	4. Placing the model garage at one end of the road	4. Putting the plate in the middle of the American service
5. Taking the pillow from the box	5. Taking the car from the box	5. Taking the napkin from the box
6. Putting the pillow next to/on the bed toward the left or right	6. Putting the car at the other end of the road/near the model garage	6. Putting the napkin on the right side of the plate
7. Taking the baby doll from the box	7. Taking the figure from the box	7. Taking the spoon from the box
8. Laying the baby doll in the cradle so that its head is on the pillow and its body is on the bed	8. Putting the figure in the car	8. Placing the spoon on the napkin
9. Taking the bedspread from the box	9. Driving the car to the garage	9. Pretending to eat with the spoon
10. Tucking the baby doll in with the bedspread	10. Putting the garage in the box	10. Putting the objects on the American service back in the box
11. Rocking the cradle	11. Putting the driveway back in the box	
12. Putting the cradle back in the box		

into account the individual characteristics of the participants and the skills that are emphasized in the literature with regard to instruction of children with ASD (Barton & Pavilanis, 2012; Lovaas, 2003). Next, the skills lists were given to the participants' class teachers, who were asked to mark the skills that they included or wish to include in the individualized education programs for the participants. Analyses of the skills marked by the teachers were then performed by the research team. The suitability of these skill analyses was evaluated by experts with doctorates in the field of special education, who were identified by the research team and who agreed to participate in the study. The final formats for the skill analyses were established in accordance with the opinions of these experts (Table 1).

The dependent variable in this research is the instruction process provided by computer-assisted activity schedules. The graduated guidance method was used in this instruction process. Here, a series of different types of prompts, placed in a hierarchy, was created, as follows: full physical prompt (manual prompt), partial physical prompt (spatial fading), shadowing, and reduction of physical contact.

The prompts gradually faded, from full physical prompts (manual prompts) to reduced physical contact during the course of the instruction. In addition, visual prompts consisting of the photographs of each skill step were included in the instruction for the role-play skills only. Right and wrong responses were recorded in order to determine the effectiveness of this education practice, and the percentage of right responses was calculated.

Experimental Design

The multiple probe design with probe conditions across participants among the single subject design was used in order to determine the effectiveness of the instruction process provided through computer-assisted activity schedules in the teaching of on-schedule skills and role-play skills to children with ASD. An experimental control was established, taking into consideration that (*a*) there is a change only in the data level or tendency of the subject upon which the practice is started to be conducted, (*b*) there is no change in the data levels or tendencies of the subjects upon which the practice has not yet been started to be performed, (*c*) similar changes in the tendencies or levels of the data occur in all situations consecutively as the practice is carried out on all subjects (Tekin-Iftar, 2012; Tekin-Iftar & Kircaali-Iftar, 2006). In this study, attention was also paid to (*a*) choosing skills at equal levels of difficulty and with equal or very nearly equal numbers of steps, (*b*) whether the instruction in relation to a skill ensures or facilitates instruction relating to another skill, thus enabling the fulfillment of the requirements of the multiple probe design with probe conditions across participants.

General Procedure

Pilot schemes were conducted with a subject, who was excluded from the main study and who possessed the prerequisite skills necessary in order for the potential problems that may have occurred during the experiment to be identified and thus eliminated. Evaluation sessions were held with the subject before the experiment process commenced in order to determine the subject's preferred reinforcer and their social interaction skills. Using this information, the reinforcers and social interaction skills were determined for each child in the main study. Photographs representing each activity and role-play-skill stage were taken before the experiment commenced. The photographs were placed on PowerPoint slides and displayed on a laptop computer. All the role-play skills and social interaction activities were included on the slides. The reinforcer photograph preferred by each subject was added at the end of each schedule. The photographs of the activities were then printed out and attached to the boxes containing the materials for each activity. Following the completion of the preparations necessary in relation to the setting and the materials, the practice stage was initialized. The practice stage consisted of a baseline probe session, a daily probe session, a full probe session, and instruction, maintenance, and generalization sessions. In all sessions, the data record forms were marked with a "+" when the subjects responded to the target stimuli correctly and with a"-" when they responded incorrectly. All of the sessions were recorded with a video camera. The study was planned jointly by all the authors and was implemented by the first author.

Baseline, Full, and Daily Probe Sessions

In the research, baseline probe sessions were held before the instruction sessions until stable data were obtained for at least three sessions in a row. The full probe session were used in order to determine the performance levels of the subjects in relation to the dependent variables before instruction. The single opportunity model was used in order to collect data

during the probe sessions. Three types of responses – namely, correct response, incorrect response, and lack of response – were collected during the probe sessions. The correct responses for the on-schedule and role-play skills were reinforced via the continuous reinforcement schedule, and incorrect responses were ignored. The probe sessions for the on-schedule skill were conducted as follows: special attention drawing prompts (e.g., "Would you like to play?") were provided to the subject in order to attract his attention. The subject received reinforcement when he indicated verbally or with gestures that he was ready for the activity, or when he did not give a negative response (e.g., "You're great!"). He was then presented with the task direction (e.g., "Let's follow the activity schedule") and given 5 seconds to respond. The subject received verbal and social reinforcement, in accordance with the continuous reinforcement schedule, when he started to fulfill the steps necessary for the on-schedule skill and when he completed each step correctly. When the subject responded incorrectly, this was ignored and the session was ended.

Probe sessions were implemented for each role-play skill as follows: special attention-drawing prompts (e.g., "Would you like to play?") were provided to the subject in order to attract his attention. The subject was reinforced by the trainer (e.g., "Well done!") when he indicated verbally or with gestures that he was ready for the study, or when he did not give a negative response. The photograph representing the skill was shown to the subject on the computer screen for 2 seconds, and materials related to each skill were placed in front of the subject. 5 seconds were then given for the subject to respond. The subject received verbal and social reinforcement, in accordance with the continuous reinforcement schedule, when he started to fulfill the steps necessary for the on-schedule skill and when he completed each step correctly. When the subject responded incorrectly, this was ignored and the session was ended. In all the probe sessions, the participation of the subject – directing his attention to the study and showing cooperation – was reinforced positively at the end of each session.

One daily probe session per day was held for the targeted skills just before the instruction sessions. These sessions continued until stable data was obtained. The daily probe sessions were held with the aim of determining the performance levels of the subjects in the skills for which instruction was being given. The same process that was used in the baseline and full probe sessions was followed in the daily probe sessions.

Instruction Sessions

The instruction for both the on-schedule skill and the role-play skills was given in an instruction session. Prompts were provided by standing behind the subject during instruction related to the on-schedule skill, without the subject being spoken to. Thus, care was taken not to interfere with the subject, schedule, materials, and activities. The graduated guidance method was used for the instruction of on-schedule and role-play skills, with the provision of computer-assisted activity schedules. Four types of prompts were included: full physical prompts (manual prompt), partial physical prompts (spatial fading), shadowing, and reduction of physical contact (until a distance of at least 2.5 m from the subject was achieved). While providing the instruction, fading was used, from full physical prompts to reduced physical contact. The faded prompt was returned when necessary. Instruction was maintained until the subjects exhibited 100% correct performance in three consecutive sessions in a row for the on-schedule skill and for each role-play skill. All of the steps in the skill analysis were instructed together at the stage of the instruction of the skills. Three types of responses were expected during the instruction sessions: correct responses, incorrect responses, and no response. A trial was held for each step, as included in the analysis for the skills being instructed. The instruction sessions were held five times a week, with one session per day.

Instruction Sessions for the On-Schedule Skill: The trainer provided the subject with an attention-drawing prompt (e.g., "Would you like to play?"). The subject was reinforced by the trainer when he indicated that he was ready for the study or did not give a negative response (e.g., "Yes! Well done"). The subject was then delivered task direction (e.g., "Let's follow the activity schedule"). Then the controlling prompt (full physical response) was provided by standing behind the subject and 5 seconds were given for the subject to respond. When the subject responded correctly, he continuously received verbal and social reinforcement using primary reinforcers. When the subject responded incorrectly, the whole instruction session was repeated. Fading was made in the type and quantity of the prompt after the subject responded correctly. When the subject responded incorrectly after the fading of the prompt, a suitable level of prompt was reinstated. At the end of the instruction session, the subject's attention was drawn to the study and his cooperative participation was reinforced positively.

Instruction Sessions for Role-Play Skills: The subject completed the first stage by clicking the left button of the mouse in order to display the photographs for the first activity on the screen (a step used also for the on-schedule skill). The subject selected the relevant plastic box containing the materials for the activity and brought it to the table. The role-play skills then started to be taught. The instruction for role-play skills was carried out in a way that was similar to the instruction process for the on-schedule skill; however, visual prompts (photographs of each step identified in the skill analysis) were used in addition to the prompts used for the on-schedule skill. The instruction prompts were faded (as was the case with the on-schedule skill), as were the visual prompts. Before fading the visual prompts, 100% performance was sought from the subject in a single session. The aim was to achieve 100% correct responses in the skill without visual prompts for three sessions in a row.

Maintenance and Generalization Sessions

Maintenance sessions were held in the first, second, and fourth weeks with the aim of ascertaining the extent to which the subjects preserved the acquired skill after the practice. Pre-test and post-test sessions were conducted for the generalization sessions. The pre-test session was held before the instruction sessions commenced, and the post-test generalization session was held after all subjects in the instruction sessions had fulfilled the criteria required in the on-schedule and role-play skills. The generalization sessions were held in two different ways: first, generalization was performed across the settings and across materials, which was important as the generalization sessions were conducted in a different setting (in the playroom). Second, the activity schedule was prepared as an activity folder rather than on a computer; here, generalization was perfomed in such a way that the materials were the same, although the setting was different. The activity folder for each subject was monitored, and the subjects' achievement regarding the on-schedule and role-play skills was assessed. At the post-test session, generalization instruction was given to the subjects who had shown a performance level of below 80%. In these sessions, prompts were provided with instant decisions as necessary and as often as required; and the graduated guidance method was used. The same instruction process was followed in the generalization instruction sessions.

Reliability

During the study, two kinds of reliability data were collected: dependent and independent variable reliabilities. Data on dependent variable (inter-observer) and independent variable (procedural) reliabilities was collected in at least 30% of the sessions held during the experimental procedure. The reliability data for the research was gathered by a coder who was studying for a Master's degree in Special Education and who did not take part in the research. Video images of each subject were watched by the same person in all sessions. Dependent variable reliability data was calculated as follows: number of agreements divided by number of agreements plus disagreements, multiplied by 100 (Tawney & Gast, 1984; Tekin-Iftar & Kircaali-Iftar, 2006).

Independent variable reliability was calculated by dividing the number of trainer behaviors observed by number of teacher behaviors planned, multiplied by 100 (Billingsley, White, & Munson, 1980; Tekin-Iftar & Kircaali-Iftar, 2006). The trainer behaviors for both on-schedule and role-play skills observed during probe, maintenance, and generalization sessions were as follows: (*a*) controlling materials, (*b*) preparing reinforcers, (*c*) providing attention-drawing prompts, (*d*) delivering task direction, (*e*) timing 5 second response intervals, (*f*) giving appropriate responses to subject's responses, and (*g*) reinforcing the attention and cooperation of the subject.

The trainer behaviors for the on-schedule skill, as observed during the instruction sessions, were as follows: (*a*) controlling materials, (*b*) preparing reinforcers, (*c*) providing attention-drawing prompts, (*d*) delivering task direction, (*e*) timing 5 second response intervals, (*f*) providing controlling prompts, (*g*) giving appropriate responses to subject's responses, (*h*) reinforcing the attention and cooperation of the subject, and (*i*) repeating the steps for the activities in the schedule.

The trainer behaviors for the role-play skills, as observed during the instruction sessions, were as follows: (*a*) controlling materials, (*b*) preparing reinforcers, (*c*) providing attention-drawing prompts, (*d*) delivering task direction (ensuring that the subject looks at the computer screen), (*e*) timing 5 second response intervals, (*f*) providing controlling prompts, (*g*) giving appropriate responses to subject's responses, and (*h*) reinforcing the attention and cooperation of the subject.

In the study, the dependent and independent variable reliability coefficients of each subject was calculated as 100% in all sessions.

Social Validity

The opinions of the class teachers and families of the subjects were sought in order to determine the social validity of the research. For this, different question formats were developed by the research team, with a view to establishing the opinions of both the teachers and families regarding the targeted skills, the activity schedule, and the findings obtained. The questions form aimed at the families included questions such as (*a*) Was there a difference between the on-schedule and role-play skills of the children before and after the instruction? (*b*) If there was a difference, what was the reason for this? The question form aimed at the teachers included questions like (*a*) Were the skills instructed in the research functional? and (*b*) Did you prefer using the practice utilized in the research? The question forms were placed in envelopes together with a DVD of videos of each child's performance and a document explaining the research, which were then given to the teachers and families. The teachers and families were asked to read the explanations, watch the videos, and then fill in the question forms. The question forms were returned by two teachers at the institution attended by the subjects and by the families, and the data was qualitatively analyzed.

Results

Effectiveness Results: Acquisition and Maintenance of the On-Schedule Skill

Data on the effect of the instruction provided through the computer-assisted activity schedule on the on-schedule skills of Burak, Can, Omer, and Alp is presented in Figure 1. When the data for the on-schedule skill is examined, it can be seen that in the first full probe condition for the on-schedule skill (including the baseline sessions), Burak gave an average of 1.6% (0%–5%) correct responses to the instruction provided through computer-assisted activity schedule. Burak fulfilled the criterion after eight instruction sessions, responding correctly at the level of 100% with regard to the targeted on-schedule skill activity. When data obtained for Can is examined, it can be seen that he did not respond correctly at all to the instruction provided through the computer-assisted activity schedule in the first two probe conditions. Can fulfilled the criterion after 41 instruction sessions, responding correctly at the level of 100%. The data for Omer shows that he did not respond correctly at all during the first three conditions. He fulfilled the criterion after 40 sessions, responding correctly to the activity at the level of 100%. The data obtained for Alp demonstrates that he did not respond correctly at all in the first four probe conditions. Alp was excluded from the research as he became ill frequently and the instruction was therefore interrupted for long periods. He refused to perform the activities and would not respond to any reinforcers after the eighth session. When the maintenance data provided in Figure 1 for Burak, Can, and Omer is examined, it is evident that each subject exhibited the on-schedule skill at the correct response level of 100% at one, two, and four weeks following the end of the instruction.

Effectiveness Results: Acquisition and Maintenance of Role-Play Skills

Data on the effect of the instruction process provided through the computer-assisted activity schedule on Burak, Can, Omer, and Alp's role-play skills (playing with the baby doll and the car, and laying the table) are included in Figures 2, 3, and 4. When the data obtained for the "playing with the baby doll" skill is examined (Figure 2), it can be seen that Burak did not respond correctly at all during the instruction provided through computer-assisted activity schedule in the first full probe condition including the baseline data. Burak gave an average of 33.3% (0%–100%) correct responses to the instruction provided using visual prompts. In the instruction sessions, the slide flow of visual prompts was faded, and Burak fulfilled the criterion for the fading, showing 100% correct performance in the third daily probe session. After the instruction sessions, Burak demonstrated a correct response level of 100% three sessions in a row as of the fourth session. In relation to Can, the data for the "playing with the baby doll" indicates that he gave an average of 2.6% (0%–8%) correct responses in the first probe condition and did not respond correctly at all in the second full probe condition. The average level of correct responses for Can for the instruction provided using visual prompts during the daily probe sessions was 30% (0%–100%). Can fulfilled the criterion for the fading of the visual prompts in the 14th daily probe session, responding correctly at the level of 100%. Following the instruction sessions, Can achieved a correct response level of 100% three sessions in a row as of the 15th daily probe session. Omer did not respond correctly at all in the first three full probe conditions for the "playing with the baby doll" skill. He gave an average of 30% (0%–100%) correct responses to the instruction provided using visual prompts in the daily probe sessions. Omer achieved 100% correct responses in the 12th daily probe session, hence fulfilling the criterion for the

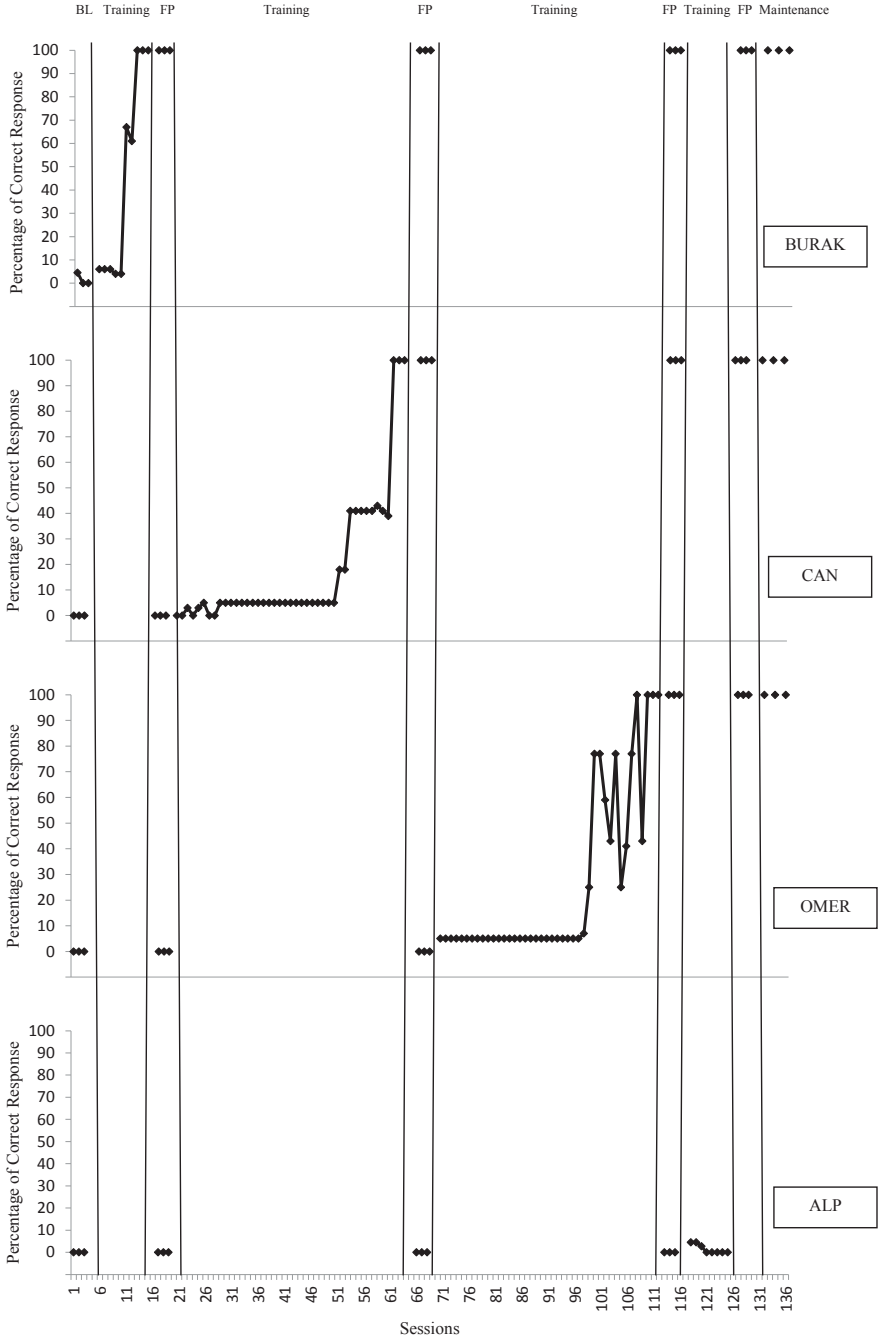

Figure 1: Percentages of correct responses from the subjects for the on-schedule skill in the baseline, full probe, daily probe, instruction, and maintenance sessions.

fading of visual prompts. Following these instruction sessions, Omer responded 100% correctly three sessions in a row as of the 13th daily probe session. The maintenance data for the skill of playing with the baby doll shows that each subject exhibited the skill at a correct response level of 100% at one, two, and four weeks following the end of the instruction.

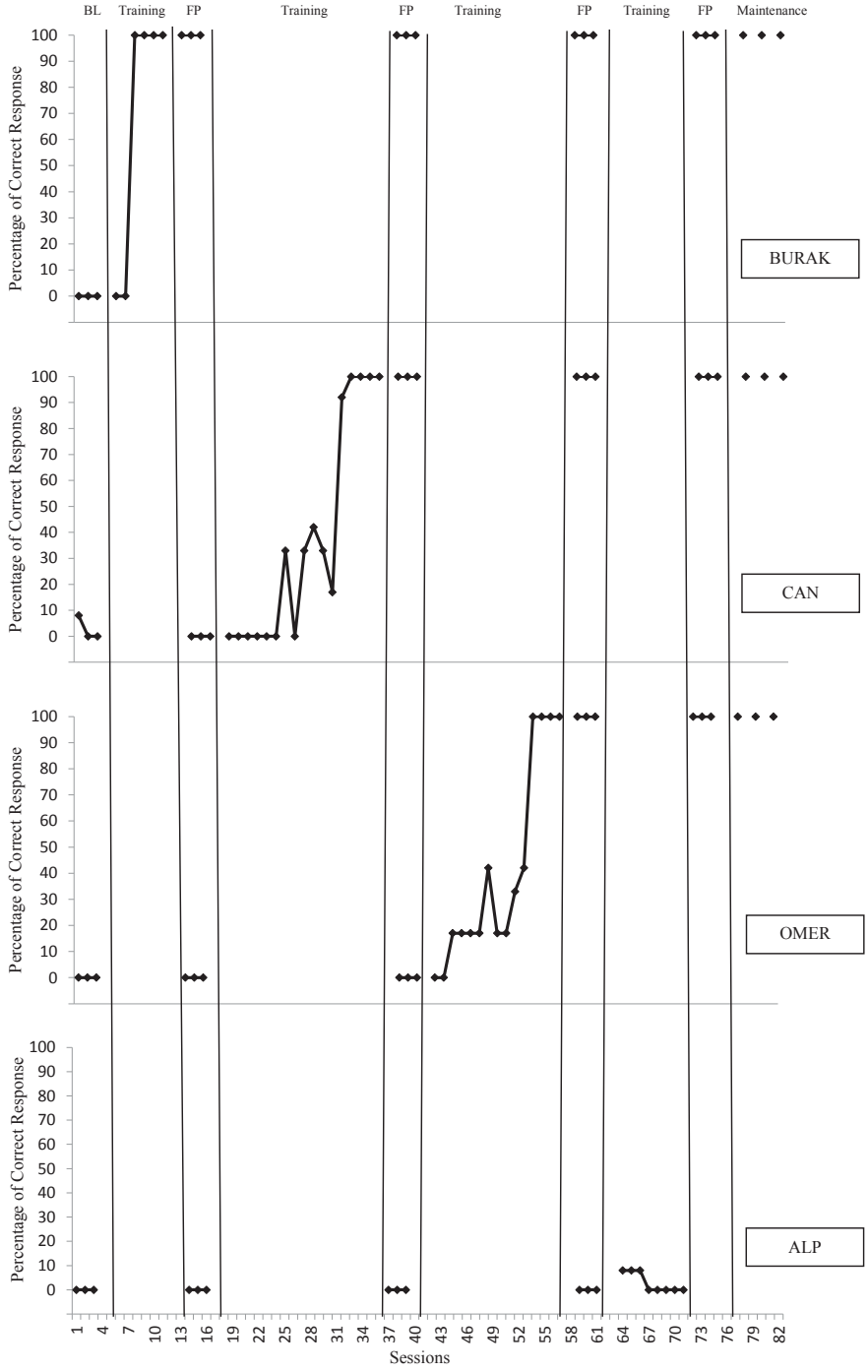

Figure 2: Percentages of correct responses from the subjects in the baseline, full probe, daily probe, instruction, and maintenance sessions for the "playing with the baby doll" skill.

The data obtained for the "playing with the car" skill (Figure 3) shows that Burak did not respond correctly at all to the instruction provided through the computer-assisted activity schedule in the first

full probe condition (including the baseline data). Burak gave an average 45.5% correct responses (0%–100%) to the instruction provided through visual prompts in the daily probe sessions. In the instruction sessions, the slide flow of visual prompts was faded, and Burak achieved 100% correct responses in the 4th daily probe session, hence fulfilling the criterion for the fading of visual

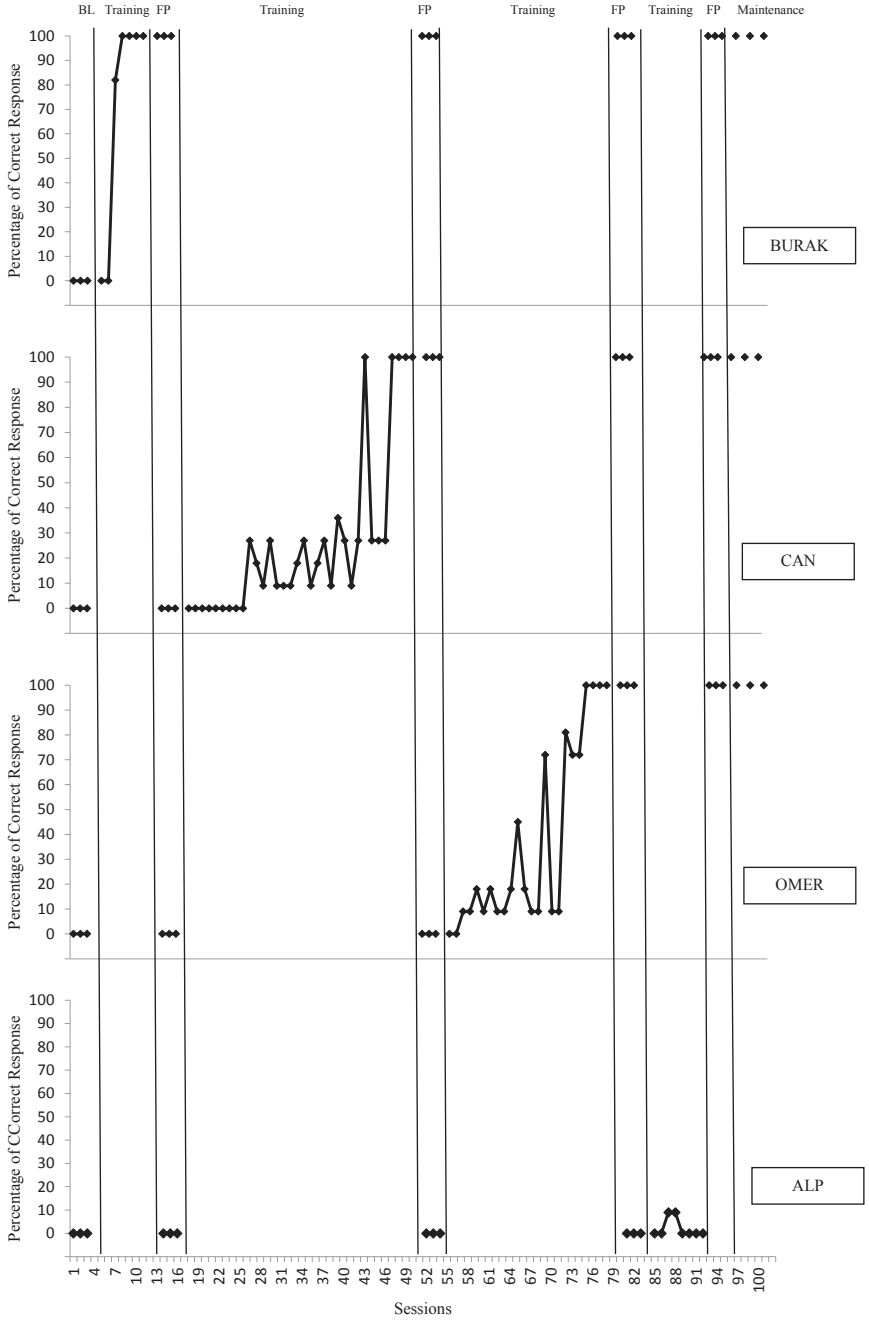

Figure 3: Percentages of correct responses from the subjects in the baseline, full probe, daily probe, instruction, and maintenance sessions for the "playing with the car" skill.

prompts. Following the instruction sessions, Burak responded 100% correctly three sessions in a row as of the 5th daily probe session. Can did not respond correctly at all in the first two full probe sessions. He gave an average 22% correct responses (0%–

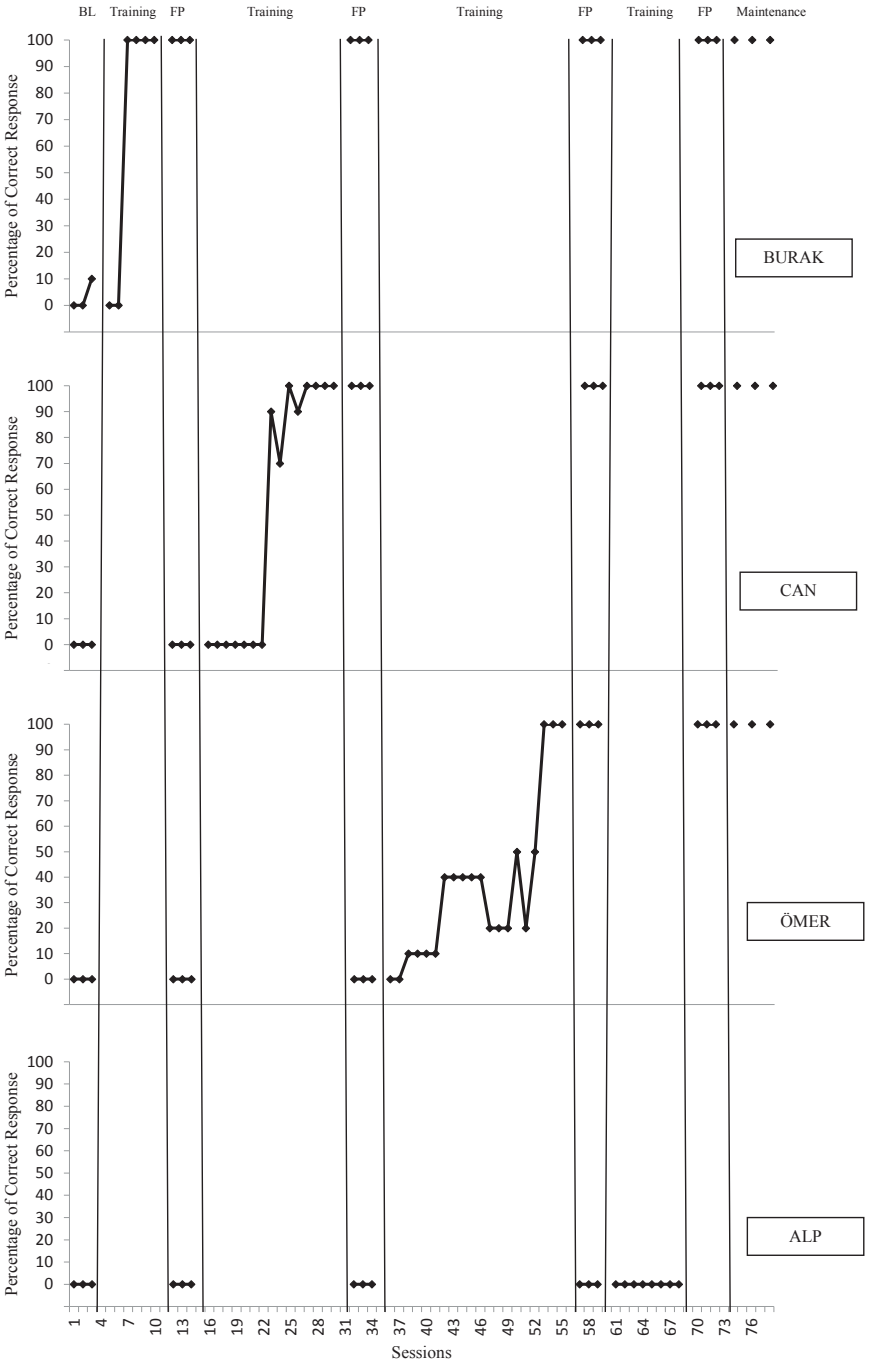

Figure 4: Percentages of correct responses from the subjects for the skill of "laying the table" in the baseline, full probe, daily probe, instruction, and maintenance sessions.

100%) to the instructions provided using visual prompts in the daily probe session. Can performed 100% correct responses in the 31st daily probe session, hence fulfilling the criterion for the fading of visual prompts. Can was able to respond 100% correctly three sessions in a row as of the 32nd daily probe session. Omer did not respond correctly at all in the first three full probe sessions for the "playing with the car" skill. Omer gave an average 32% correct responses (0%–100%) in the daily probe sessions and showed a performance of 100% correctness in the 21st daily probe session, thus fulfilling the criterion for the fading of visual prompts. Following these instruction sessions, Omer responded 100% correctly three sessions in a row as of the 22nd daily probe session. The maintenance data for the skill of "playing with the car" showed that each subject exhibited a correct response level of 100% at one, two, and four weeks following the end of the instruction.The data obtained for the skill of "laying the table" (Figure 4) shows that Burak responded correctly at an average level of 3.3% (0%–100%) in the first full probe condition, comprising the baseline data on the laying the table play skill in the instruction process provided through the computer-assisted activity schedule. Burak gave 33.3% correct responses (0%–100%) to the instruction provided using visual prompts in the daily probe sessions. As with the other instruction sessions, the slide flow of visual prompts was faded, and Burak gave 100% correct responses in the 3rd daily probe session, fulfilling the criterion for the fading of visual prompts. After the instruction sessions, Burak responded 100% correctly three sessions in a row as of the 4th daily probe session. Can did not respond correctly at all in the first two full probe sessions. He gave an average 46% correct responses (0%–100%) to the instructions provided using visual prompts in the daily probe sessions. Can fulfilled the criterion for the fading of visual prompts in the 12th daily probe session, giving 100% correct responses. Following the instruction sessions, Can responded 100% correctly three sessions in a row as of the 13th daily probe session. Omer did not respond correctly at all in the first three full probe conditions. Hi average correct response level to the instructions provided using visual prompts was 33% (0%–100%). Omer achieved 100% correctness in the 18th daily probe session, hence fulfilling the criterion for the fading of visual prompts.

Omer responded 100% correctly three sessions in a row as of the 19th daily probe session. In terms of maintenance data, each subject exhibited the skill of laying the table at a correct response level of 100% at one, two and four weeks following the end of the instruction.

Effectiveness Results: Generalization

When the effects of the instruction process provided through computer-assisted activity schedules on the generalization of on-schedule and role play skills were examined, it was seen that all three subjects generalized the skills that they acquired across different settings and materials and at a level that fulfilled the criterion. None of the three subjects gave any correct responses at all in the pre-test sessions held with the aim of determining the subjects' performance levels in the generalization of skills taught via instruction provided through the computer-assisted activity schedule; however, all three exhibited 100% correct responses in the post-test sessions. Upon examining the data on the generalization of the skills taught using the computer-assisted activity schedule to the activity folder, it was seen that Burak responded correctly in a way that fulfilled the criterion without the need for generalization instruction sessions. Can started to give correct responses at a level fulfilling the criterion after one generalization instruction session, and Omer did so after two generalization instruction sessions. As stated previously, no correct responses were given at all by the subjects in the pre-test sessions held with the aim of determining their performance levels on the generalization of these skills; however, Burak exhibited a 100% correct response rate in the post-test sessions. Can had an average correct response level of 23% in the post-test generalization session, and he exhibited 100% correct responses after a generalization instruction session held thereafter. Omer demonstrated a 5% correct response in the post-test generalization session, after which two generalization instruction sessions were held, which led to Omer achieving a correct response rate of 100%.

Social Validity Results: Opinions of the Parents

An examination of the opinions of the mothers of the subjects (3) on the social validity of the study, shows that they expressed positive opinions regarding the importance of the skills taught and the appropriateness of the practice used in teaching these skills. The mothers of Burak and Omer indicated that in the videos of the sessions prior the instruction, their children just looked around, without paying attention to anything; however, their children paid

attention to the activities after the instruction and fulfilled the skills completely. Can's mother stated that, while in the videos before the instruction, her son exhibited behavioral problems, constantly trying to open and close the laptop computer lid and to push the computer off the table, after the instruction, all of her son's behavioral problems were gone and he completed the activity properly. All three mothers expressed that their children were freed from being dependent on someone through this practice, understanding what to do when they saw the photographs, without needing any commands. Burak's mother said that she was pleased, as her son generalized the play skills learned to the home setting, starting to play more appropriately. Furthermore, she stated that this practice could be repeated and would be beneficial in facilitating play with normally functioning peers and, therefore, socialization. Omer's mother expressed that she would like to use this method at home and that she would be grateful to be given help in this regard.

Social Validity Results: Opinions of the Teachers

An examination of the opinions of the participants' teachers (2) on the social validity of the study showed that the teachers had positive opinions regarding the importance of the skills taught and the appropriateness of the practice used in the instruction of these skills. The teachers indicated that the fulfillment of on-schedule and role-play skills is significant for children, especially at this age, stating that the students' normally functioning peers also play such games. The teachers expressed that they would consider using the instruction process provided through the computer-assisted activity schedule in this study in both one-to-one and group instruction. They stated that the use of the computer-assisted activity schedule is effective and, thus, can be included in the daily instruction program for their students. In addition, they emphasized that necessary arrangements in the class must be conducted before such instruction is undertaken, and whether students possess the prerequisite skills is needed to assess by such studies as well. When the teachers were asked which aspects of the study they like the most, they stated that they liked how different this practice was from traditional instruction methods, how the students played independently, that the practice was attention-grabbing, and that the computer was used effectively. When the teachers were asked which aspects they disliked the most, they indicated that it was disadvantageous that the computer could not be taken everywhere and that the students were playing on their own, without interacting with others.

Discussion

This study aimed to examine the effectiveness of instruction provided through computer-assisted activity schedules on the acquisition, maintenance, and generalization of on-schedule and role-play skills in children with ASD. Furthermore, the opinions of the teachers and mothers of the children participating in the study on the instruction provided were examined in order to determine the social validity of the study.

The findings regarding the effectiveness of the study showed that the instruction provided through computer-assisted activity schedules is useful in the teaching of on-schedule and role-play skills. The findings are similar to those obtained in a small number of studies into the instruction provided via activity schedules using such technological means as computers and the iPod Touch (Apple Inc.) (Carlile et al., 2013; Cihak, 2011; Dauphin et al., 2004; Kimball et al., 2003, 2004). Only one study was encountered in the literature in which play skills were taught through activity schedules prepared on a computer. In this study by Dauphin et al. (2004), socio-dramatic play skills were taught to a child with ASD through an instruction process that used computer-based activity schedules with embedded videos and using matrix training together. Notably, in their study, photographs representing the activities and the steps in the skill analysis were embedded in the activity schedules, and instruction on three different role-plays, in addition to the on-schedule skill, was conducted in a single instruction session.

The findings of our study also parallel the results of research that questions the effectiveness of instruction provided through traditionally prepared activity schedules (in the form of activity folders) upon on-schedule and play skills (Bryan & Gast, 2000; Cuhadar & Diken, 2011; Machalicek et al., 2009; Morrison et al., 2002). Only three studies aimed at increasing play skills through the use of toys and through playing garden games were encountered in the literature (Cuhadar & Diken, 2011; Machalicek et al., 2009; Morrison et al., 2002). Indeed, no such research, in which role-play skills are taught via instruction provided through computer-assisted activity schedules, was encountered. Thus, it can be considered that this research both supports the findings obtained in other studies and contributes significantly to the expansion of the literature.

The study differs from similar research into instruction provided through computer-based activity schedules, in which embedded videos have been used (Carlile et

al., 2013; Cihak, 2011; Dauphin et al., 2004; Kimball et al., 2003, 2004). In contrast, in our study, photographs were embedded into slides on Microsoft PowerPoint. Furthermore, other studies have used participants who know how to maintain an activity schedule. Distinctively, in this study, the instruction for both the on-schedule skill and the role-play skills was perfomed together. Furthermore, upon examining other studies, it becomes evident that many of the examples are case studies and that there are methodological limitations (Cihak, 2011; Dauphin et al., 2004; Kimball et al., 2003, 2004). For example, Cihak (2011) examined the effectiveness of instruction provided through activity schedules that were expanded with videos and activity folders containing photographs. It is not possible to talk about the differentiating effects of the practices in Cihak's study due to the use of multiple practices and the transporting effects, which threaten the internal validity of a study. Furthermore, the fact that there are many similarities in the skill steps for on-schedule skills in both practices affects the internal validity of Cihak's study negatively. The on-schedule skill was obtained in both practices related in the research; however, this approach makes it harder to determine at the end of which practice acquisition was ensured. When it comes to our study, a multiple probe design with probe conditions across participants was used, and attention was paid to control factors threatening the experimental control. Thus, by examining these differences, it can be seen that our research supports and expands the findings obtained in previous research into the subject.

The findings of this study show that the subjects maintained the on-schedule and role-play skills at a correct response level of 100% one, two, and four weeks following the instruction process provided through computer-assisted activity schedules. When scrutinizing previous studies, it can be seen that data on maintenance was collected in only three examples (in which the maintenance of the skills acquired was also demonstrated) (Carlile et al., 2013; Dauphin et al., 2004; Kimball et al., 2004). Koyama and Wang (2011) conducted a compilation study, analyzing 23 studies that have used activity schedules containing photographs prepared either traditionally or with technological tools. The collection of maintenance data was reported in only six of these studies. It can be said that the findings on the effects of maintenance match and support the results obtained in previous research.

This study also showed that the subjects could generalize the on-schedule and role-play skills obtained using the instruction process provided through computer-based activity schedules to different settings and materials at a level of 100%. Looking at similar studies (Cihak, 2011; Carlile et al., 2013; Dauphin et al., 2004; Kimball et al., 2003, 2004) generalization sessions were included across the board, except for in Cihak's experiment (2011). In their compilation work on the subject, Banda and Grimmet (2008) report that generalization sessions were held in six of 13 studies that they examined, and Koyama and Wang (2011) indicate that generalization sessions were held in eight of 23 studies included in their paper. In these studies, the subjects were able to generalize the skills acquired to different settings, materials, and people. It is observed, therefore, that the generalization findings of the research are consistent with the findings of previous research.

Previous work examining the use of computer-based activity schedules emphasizes that children with ASD can learn schedule maintenance more quickly and easily when using a computer because the device itself acts as a reinforcer; however, it has also been suggested that it is functionally useful to generalize schedules prepared on the computer by converting them to paper form because the activity folder is cheaper, easier to use, and more adaptable and portable than those prepared on the computer (Kimball et al., 2003, 2004; Stromer et al., 2006). Thus, it is recommended that activity schedules prepared on the computer are used for the teaching of new skills, and that these skills are then generalized into an activity folder consisting of the same activities as soon as the new skills have been acquired (Stromer et al., 2006). Only one study was encountered in which skills were generalized from the computer to an activity folder (Kimball et al., 2004). Bearing this knowledge in mind, in our study, different generalization sessions were held for each skill obtained by the subjects to enable the transfer of skills to the use of the activity folder. It was seen that one of the subjects could generalize the skills that he had acquired to the activity folder without any help at a level of 100% (using photographs in a different environment but with the same materials). Of the other two subjects, one could generalize the skills after just one instruction session and the other managed this after two instruction sessions. While the generalization conducted in this study was similar to other studies in terms of the use of different settings and materials, the method also diverged from the norm due to the generalization of the on-schedule skill from the computer to the activity folder. Thus, it can be considered that this research both supports the generalization findings obtained in previous studies and expands the literature on the subject.

While the findings on the effectiveness of the research are positive, it is necessary to discuss certain points further. An examination of the data obtained regarding the on-schedule skill (Figure 1), shows that Burak gave 100% correct responses by the 7th daily probe session, with Can achieving this in the 41st session and Omer in the 40th session. It can be seen that there was no steady increase in the correct response percentage by the 29th instruction session for Can and the 28th instruction session for Omer; however, there was a continuing increase in the correct response percentage following these instruction sessions. It can be suggested that this increase occurred after the subjects fulfilled the criterion by acquiring the role-play skills as the aim was for the subjects to complete the play activities correctly in terms of the steps of skill analysis on the activity schedules. Another point of discussion is that the data for the on-schedule skill for Omer, and on the "playing with the car" skill for Omer and Can, showed variability. One explanation for this is that the intensive attention deficit and obsessive behaviors of the children interfered with the completion of the activities. In addition, distraction and the exhibition of obsessive behaviors during one step in the skill analysis may have led to a disconnection in the next step, thus causing incorrect behaviors to be manifest, as the targeted skills are chain skills. The single opportunity method was used in the research in order to determine the performance of the children, and their performances in all the remaining steps were recorded as incorrect as the children stuck around a step while they can fulfill the next skill step. Considering this point, the use of the multiple opportunity method, rather than the single opportunity, is recommended when holding probe sessions in intervention settings.

The social validity findings of this research showed that both the parents of the children participating in the research and the class teachers at the educational institutions that the children attend had positive opinions regarding the instruction process and the skills taught via computer-assisted activity schedules. Koyama and Wang (2011), in their compilation study, report that the social validity findings were included in 30% of the studies that they examined and that positive opinions were expressed with regard to the instruction process, in line with our findings. In terms of studies that examine the effects of the instruction process provided through computer-assisted activity schedules, only one case study that can be regarded as including social validity data was encountered; here, the relevant information was obtained via informal interviews with the families of the subjects (Kimball et al., 2003). In Kimball et al.'s study, in accordance with our work, the families expressed that they were happy with their children doing things on their own and making progress in the skills. In addition, the class teachers indicated that computer-assisted activity schedules are applicable in the teaching of various skills within individual and group contexts. As such, it can be said that the social validity findings on the instruction provided through computer-assisted activity schedules support existing findings and contribute further to the literature.

There were some limitations to our research, despite the positive findings. A decision was taken to exclude one subject from the research due to illness, interruption, and extensive behavior problems, as stated earlier; thus, a subject loss occurred. Hence, the findings of the research were limited. The single opportunity method was used in the probe sessions in order to assess the performance of the subjects throughout the research. Data on the incorrect responses of the children could not be collected and error analysis could not be perfomed as a realistic error analysis pattern could not be obtained with this method. This constituted another limitation with regard to the study.

Suggestions can be made with regard to future research, starting from the findings and limitations of this study. Similar work could be repeated with different trainers (e.g., parents and paraprofessionals), teaching different skills to subjects with different characteristics. The effects using different technological tools, such as iPods and iPads, could also be investigated. Furthermore, the effectiveness and efficiency of different instruction processes provided through traditionally prepared activity schedules supported with technological tools could be compared. The comparative effectiveness of using videos in the instruction process could be investigated and the effects of using different supportive instruction practices, such as matrix training, correspondence training, and choice making, could also be examined. Lastly, the use of activity schedules in group instruction and mainstreaming environments might also be explored.

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